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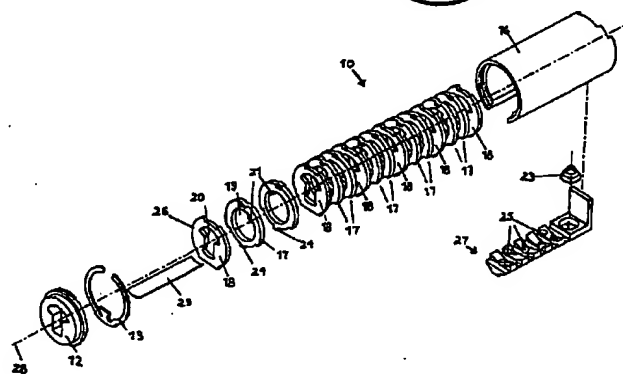
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(54) Title: A LOCK BARREL ASSEMBLY AND KEY THEREFOR



(57) Abstract

A lock barrel assembly (10) operable by a key (11) and adapted to be received within a hollow lock body (15) comprises a hollow base (16) having a longitudinal axis (28). At least one disk (17) is rotatably supported in base (16) and extends generally to axis (28). The disk (17) has an aperture (19) for passage of the key (11) and a key engaging means (21) which is adapted to engage key (11) so that it is capable of locating disk (17) at a predetermined position about axis (28). A locking bar (27) is operatively associated with disk (17) and is adapted to move radially relative to axis (28) from an outer position to an inner position when disk (17) is located in its predetermined position by key (11).

This invention relates to key operable locks.

Conventional locks consist of a lock barrel rotatably received within a lock body. The lock barrel is provided with spring loaded pins. The lock is operable by a key having a key blade, the profile of which co-operates with the spring loaded pins; some lock barrels include locking or side bars which are permitted to move radially inwardly when the pins are properly positioned, allowing the barrel to be rotated to the unlocked position.

- 10 These conventional locks are prone to tampering and may be "picked" with relative ease. In addition, the number of possible combinations is limited. The lock barrel is of complex construction and is therefore expensive to manufacture, repair or alter, requiring a vast number of parts to be held in stock by locksmiths.

It is an object of the present invention to overcome or at least substantially alleviate some or all of the above disadvantages.

- 20 Accordingly, the present invention provides, in one aspect, a lock barrel assembly operable by a key and adapted to be received within and rotatable in a hollow lock body when the lock barrel assembly is in an unlocked configuration, the lock barrel assembly comprising a hollow base having a longitudinal axis, at least one disk rotatably supported in the base and extending generally normal to the axis, the or



each disk having an aperture for passage of the key, a key engaging means adjacent the aperture and adapted to engage the key so that the key is capable of locating the or each disk at a predetermined position about the longitudinal axis

5 without the rotation of the key, and at least one locking bar operatively associated with the or each disk and adapted to move radially relative to the longitudinal axis from an outer position to an inner position only after the or each disk is located in its predetermined position by the
10 key, characterised in that the or each disk includes a projection or pin adapted to be received in a slot, groove, hole or the like in the or each locking bar to enable the locking bar to move radially to the inner unlocked position whereby the lock barrel assembly is capable of rotating
15 within the hollow lock body.

In another aspect, this invention provides a key for operating the lock barrel assembly, the key bearing at least one longitudinal angled track adapted to receive the key engaging means.

20 The hollow lock body into which the lock barrel assembly of the invention may be received may be selected from a wide range, so that the combined lock barrel assembly and hollow lock body may be used as a cylinder lock, cam lock,
1 furniture lock or padlock, inter alia. The lock barrel
25 assembly of the invention may fulfil a wide range of locking functions, simply by changing the selection of the hollow lock body.



The number of disks in the assembly can determine the range of possible combinations. Preferably, two or more disks are used. For simplicity of description, reference will be made to a plurality of disks. However, it is to be understood

5 that the invention is operable with only one disk.

Conveniently, the aperture for passage of the key is centrally located in each disk.

The key engaging means may take any suitable form; preferably the key engaging means comprises one or more
10 projections extending into the disk aperture.

For the sake of economy, it is convenient if there is only one locking bar in the assembly of the invention.

In an especially preferred embodiment, both the locking bar and the key are cut to the same "code" supplied by computer

15 software. However, in the interests of security, the physical correlation between the locking bar and the key should differ markedly, so that even when placed side by side there is no apparent resemblance. This lack of physical resemblance is possible because the disks comprise transfer
20 or scrambling means linking the locking bar and the key. As the key is inserted into the lock barrel assembly and the



-4-

key arranges the disks in their predetermined positions, the disks essentially pick up the "code" from the key. The "code" is transferred unchanged to the locking bar, even though the physical configuration of the locking bar is
5 different from that of the key.

Optionally, a disk-like washer may be included in the lock barrel assembly of the invention. Unlike the disks which are rotatably supported within the hollow base, the washer may be stationary until the locking bar has moved to the
10 unlocked position, at which time the washer can be rotated with the whole assembly.

The washer has an aperture which is preferably the same as that of the key profile so that the washer can act as a guide for the key and transfer the turning action of the key
15 to the whole assembly. If desired, a plurality of washers may be included in the assembly. The washers may also incorporate eyelets to help prevent "picking", as explained further, below.

As indicated above, the disks are rotatably supported within
20 the base. Especially when washers are included, the angle supporting the arc of rotation of the disks may be limited if desired.

In a particularly preferred embodiment, the assembly has 10 disks arranged in 5 pairs. Between each pair is a washer
25 with a key profile aperture. The disk and washer combination

SUBSTITUTE SHEET

-5-

is conveniently held in place by a case hardened plug which contains the key profile aperture. (The plug may also serve to prevent drilling of the lock barrel assembly.) This embodiment provides a lock assembly which has both strength
5 and an enormous number of combinations, as explained below.

In this embodiment, the key engaging means comprises a projection or pin on each disk, which is limited in rotation to 36 degrees. The predetermined position which can be occupied by the projection on each disk can be selected from
10 seven possibilities, each at 6 degree intervals within the 36 degree arc. Because 10 disks are used, there are more than 280 million combinations available. In addition, the disks may be loaded so that the first disk (nearest the plug) can have its projection lying either to the right or
15 to the left. This doubles the number of available combinations.

The key of the invention may be circular in cross-section or may have sections removed to give it the required shape, such as that of a keyway. One suitable material for the key
20 is nickel-silver. The key may comprise a key blade which operates the locking assembly and a key head for gripping. In the remainder of this description reference will be made to the key blade as the operative part of the key.

Where the key blade is cut from a cylinder, with sections
25 removed so that the cross-section of the blade resembles a

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keyway, the top of the cross-sectional profile is preferably between 140 degrees and 160 degrees, with the diameter of the blade being between 7 and 8mm. The blade may have a pointed start with a second leading angle up to the point where all cuts start or end.

The key blade may have a track or slot machined into it, preferably incorporating programmed angles.

In this embodiment, the cutting of a key involves the machining of the track or slot into the cylindrical section. This track may be cut by a specially manufactured disposable slot drill with a chamfer cutting edge. The track is cut lengthwise into the key blade and changes radially in angles as it progresses. The cutter should always be oriented towards the centre of the key blade.

The cut key blade may feature more than one track. For example, there may be two tracks, with each track adapted to align half the disks. The first track starts at the point of the key, changing direction up to ten times to arrive at the end of the key blade near the key head. The track may end there, or continue over the apex of the key blade to form the second track which runs back to the key point, again changing direction up to twelve times before finishing at the point of the key. Both tracks are cut into the same curved surface.

When the key blade enters the lock assembly of the invention, the key engaging means - e.g., a projection into



-7-

each disk aperture - steps through the programmed changes of direction in the track and the disks rotate accordingly. The position of the track on the key blade, the number and route of the changes in direction and the number of tracks per key blade can be varied, resulting in an extremely large number of possible key profiles.

It should be noted that the key of the present invention can be manufactured so that it contains no sharp points or projections and thus will not scratch, or tear clothing, as is the case with many existing keys.

As indicated above, the locking bar has two positions. In the first or outer position, the locking bar is preferably retained in a groove in the hollow lock body and while the locking bar is in this position, the lock cannot be opened. The locking bar is retained in this position by external projections or pins on the disks.

When the correct key is inserted in the lock barrel assembly, the disks are rotated so that the external projections or pins align with the slots, grooves, holes or the like in the locking bar. By turning the key, the locking bar is pushed from its groove in the hollow lock body and meshes with the projections or pins. Thus the lock barrel assembly can rotate, permitting unlocking.

Because the projections or pins are meshed with the slots, grooves or holes in the locking bar, the key cannot be

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-8-

withdrawn from the locking bar assembly until the locking bar is returned to its groove in the hollow lock body. A spring biases the locking bar to the outer position, so that continuous turning of the key will be interrupted by the spring-loaded locking bar dropping back into the groove when the bar is aligned therewith, indicating the position at which the key can be withdrawn. As the key withdraws, it "scrambles" the disks as they step through the angles in the track or tracks.

- 10 The locking bar is conveniently made of brass or nickel-silver and may have slots or grooves which extend longitudinally as well as radially. Alternately, as already indicated, holes may be drilled into the locking bar. Preferably, any holes are drilled blind. Even more preferably, extra more shallow holes are drilled - typically, 3 to 4 per locking bar - as an anti-picking feature. These shallow holes will not be capable of meshing with projections on the disks.

20 If desired, the locking bar may carry a mixture of slots, grooves and/or holes.

In the case of a master lock system, the locking bar will contain a large number of operable slots, grooves and/or holes.

25 It will be appreciated that the locking bar is an important feature of the present invention. It affords a high degree

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-9-

of flexibility to the lock of the invention as well as security. In addition, the use of a locking bar instead of key pins as in the prior art locks enables rapid and economic alteration. All that is required is the generation
5 of a new key/locking bar combination and the replacement of the old locking bar with the new one. Whereas a skilled locksmith is needed to alter the combination on prior art locks, an average handyman will be able to change the locking bar in the case of the lock barrel assembly of the
10 present invention.

If desired, a cover plate may be included in the lock barrel assembly for each locking bar, so that the "code" of grooves, slots or holes therein cannot be observed with the aid of an endoscope, for example.

15 Preferred forms of the present invention will now be described by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is an exploded isometric view of a lock
20 assembly according to the invention;

Figure 2 is a perspective view of a key blade suitable for use with the lock assembly of Figure 1;

Figure 3 is a longitudinal sectional view of the lock assembly of Figure 1, in assembled form and including a
25 hollow lock body;

Figures 4A to 4E illustrate (in cross-section) the lock

SUBSTITUTE SHEET

-10-

assembly of Figure 1 (received in a hollow lock body) during operation, so that Figure 4A shows the locked position, Figure 4B illustrates the lock with key inserted, in Figure 4C the lock is in the unlocked position, in Figure 4D the lock barrel has been rotated to the start position; and
5 Figure 4E shows the locked position again; and

Figure 5 illustrates the "anti-pick" option.

Referring first to Figures 1, 2 and 3, there is depicted a lock assembly 10 to be operated by a key having a key blade
10 11.

Lock assembly 10 is adapted to be received in a hollow lock body 15 (refer Figures 3 and 4A to 4E). On the internal surface of lock body 15 is a longitudinally extending groove
14.

15 Assembly 10 is of a generally cylindrical configuration and includes base portion 16 which is C-shaped in transverse cross-section and which has an outer surface which slidably engages the internal surface of lock body 15. Located between the arms of base portion 16 is a locking bar 27. In
20 the locked position, locking bar 27 is received in groove 14. Spring 23 biases locking bar 27 to the outer position.

Slidably received in base portion 16 are five pairs of disks 17 spaced by washers 18. Each disk 17 is of thyroidal configuration so as to provide a central passage 19. Washer
25 18 is also of thyroidal configuration and provides a

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-11-

passage 20. Disks 17 and washer 18 extend generally transversely of the longitudinal axis 28 of lock assembly 10. Passage 20 has a configuration to match generally the transverse configuration of key blade 11.

- 5 Projecting into each passage 19 is an engagement projection 21, which is adapted to be received in slot or track 22 in key blade 11. The radially outer peripheral surface of each disk 17 is provided with a projection 24 which is adapted to be received in holes 25 formed in locking bar 27. There are
10 also provided further projections 26 on disks 17 and washers 18 to engage complementary surfaces on base portion 16, to aid rotation of assembly 10 when blade 11 is turned. Plug 12 and circlip 13 serve to secure assembly 10.

- In operation of the above described lock, when key blade 11
15 is inserted, the projections 21 of disks 17 engage track 22 and are angularly oriented about longitudinal axis 28 of lock assembly 10, with the progress of blade 11 into lock barrel assembly 13. When blade 11 has been fully inserted, projections 24 are radially aligned with holes 25. This, in
20 combination with the tapered sides of groove 14 (see Figure 4A to 4E), permits locking bar 27 to move radially inwardly.

Accordingly, when key blade 11 is turned, lock assembly 10 will also rotate as the locking bar 27, having been permitted to move radially inwardly, clears groove 14.

- 25 If key blade 11 does not have the correct configuration of slot 22, bar 27 is prevented from moving radially inwardly

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because projections 24 will not line up with holes 25. Accordingly, projections 24 will abut the inner surface of locking bar 27, preventing its radial inward movement. Bar 27 will therefore be retained in groove 14 and prevent the
5 lock barrel assembly 10 from rotating.

The key blade 11 depicted in Figure 2 is intended to be joined at end 30 to a key head (not shown) to be gripped by the user. Key blade 11 is of "keyway" shape in transverse cross-section, as can be seen from end 30. Opposite end 32
10 is shaped to a point, to aid insertion of key blade 11 in lock barrel assembly 10 and to assist alignment of projections 21 in track 22.

As a precaution against unauthorised manipulation of the locking barrel assembly 10, cover shield 29 (see
15 figures 1 and 3) is inserted through passages 19 and 20 in disks 17 and washers 18, so as to cover the pattern of holes 25 in locking bar 27 and to prevent "reading" of the pattern of holes by an endoscope or the like.

Referring now to Figures 4A to 4E, in Figure 4A the lock
20 assembly is in the locked position, with disks 17 scrambled. Locking bar 27 is held in groove 14 of base portion 16 which in turn is received within hollow lock body 15. The lock assembly cannot rotate within body 15 in this configuration.

In Figure 4B, key blade 11 has been inserted in passage 19.
25 Disks 17 have projections 21 which are properly aligned by the track on key blade 11 to match the drilled pattern in

SUBSTITUTE SHEET

-13-

locking bar 27.

Figure 4C illustrates the unlocked position. Key blade 11 has been rotated to mesh locking bar 27 with disks 17. Locking bar 27 has moved radially inwardly from its former position in groove 14, enabling rotation of the lock assembly within body 15. Disks 17 are prevented from turning by locking bar 27, so removal of key blade 11 is not possible.

As shown in Figure 4D, continuous turning of key blade 11 is interrupted when the spring-loaded locking bar 27 drops back into groove 14. Key blade 11 can then be withdrawn.

Removal of key blade 11 will scramble disks 17, keeping locking bar 27 engaged between lock body 15 and base portions 16, as shown in Figure 4E.

Referring now to Figure 5, there is depicted an optional feature comprising a means of inhibiting "picking" of the lock.

Disks 17 are provided with a friction surface 35, which in this particular embodiment is a serrated surface. Washers 18 are provided with eyelets 36. Mounted at the internal end of lock barrel assembly 10 is a plug 37 which is movable longitudinally of axis 28. Plug 37 is spring biased towards disks 17. Attached to and moved longitudinally with plug 37 is a brake bar 38 which has cam surfaces 39.

In operation of the lock, disks 17 co-operate with locking

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-14-

bar 27 in the same manner as previously described. However, in this particular embodiment, plug 37, prior to insertion of key blade 11, prevents inwardly radial movement of bar 27. When key blade 11 penetrates the lock and is pushed to the innermost limit to the extent of abutting plug 37, it causes plug 37 to move in the direction of arrow 40, freeing locking bar 27. However, when key blade 11 is fully inserted, not only does plug 37 free locking bar 27, but also cam surfaces 39 engage eyelets 36 so that brake bar 38 engages surfaces 35 and prevents angular movement between washers 18 and disks 17.

Accordingly, disks 17 are retained in their correct angular orientation. Should plug 37 be pushed in the direction of arrow 40 to free the locking bar 27 for picking purposes, brake bar 38 prevents angular movement between washers 18 and disks 17, and disks 17 cannot be rotated by "picking".

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CLAIMS

1. A lock barrel assembly operable by a key and adapted to be received within and rotatable in a hollow lock body when the lock barrel assembly is in an unlocked configuration, the lock barrel assembly comprising a hollow base having a longitudinal axis, at least one disk rotatably supported in the base and extending generally normal to the axis, the or each disk having an aperture for passage of the key, a key engaging means adjacent the aperture and adapted to engage the key so that the key is capable of locating the or each disk at a predetermined position about the longitudinal axis without rotation of the key, and at least one locking bar operatively associated with the or each disk and adapted to move radially relative to the longitudinal axis from an outer position to an inner position only after the or each disk is located in its predetermined position by the key, characterised in that the or each disk includes a projection or pin adapted to be received in a slot, groove, hole or the like in the or each locking bar to enable the locking bar to move radially to the inner unlocked position whereby the lock barrel assembly is capable of rotating within the hollow lock body.
2. A lock barrel assembly as claimed in claim 1, wherein the hollow lock body is suitable for use as a cylinder lock, a cam lock, a furniture lock or a padlock.
3. A lock barrel assembly as claimed in claim 1 or 2 wherein the key engaging means comprises one or more projections



extending into each disk aperture.

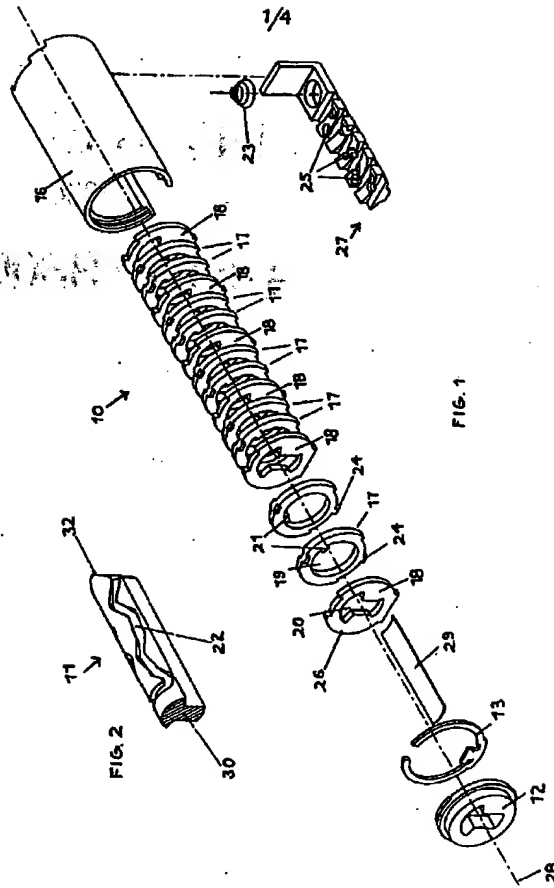
4. A lock barrel assembly as claimed in any one of claims 1 to 3, wherein the or each locking bar includes in addition shallow holes not capable of receiving the projection or pin.
5. A lock barrel assembly as claimed in any one of claims 1 to 4, which includes at least one disk-like washer.
6. A lock barrel assembly as claimed in any one of claims 1 to 5, wherein there are two or more disks.
7. A lock barrel assembly as claimed in any one of claims 1 to 6, wherein there is a single locking bar.
8. A lock barrel assembly as claimed in any one of claims 1 to 7, wherein there are 10 disks, arranged in 5 pairs, each pair being separated by a washer with a key profile aperture.
9. A lock barrel assembly as claimed in any one of claims 5 to 8, wherein means are provided to prevent rotation of the disks.
10. A lock barrel assembly as claimed in any one of claims 1 to 9, wherein a cover shield is provided to prevent inspection of the locking bar.
11. A key for operating the lock barrel assembly as claimed in any one of claims 1 to 10, wherein the key bears at least one longitudinal angled track cut into a curved surface, the track being adapted to receive the key



12. A key as claimed in claim 11, which bears two said tracks, both cut into the same curved surface.
13. A lock barrel assembly as claimed in claim 1, substantially as herein described with reference to Figure 1 or Figure 3 of the accompanying drawings.
14. A key as claimed in claim 11, substantially as herein described with reference to Figure 2 of the accompanying drawings.



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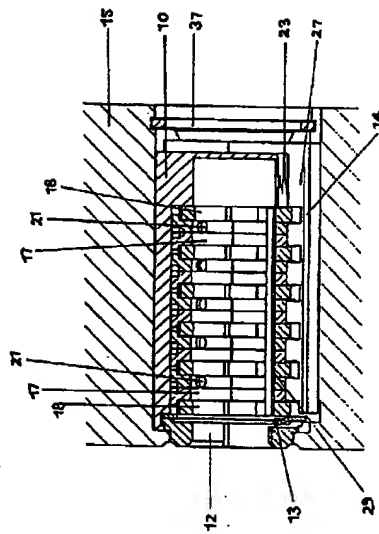


FIG. 3

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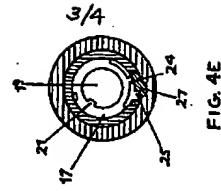


FIG. 4E

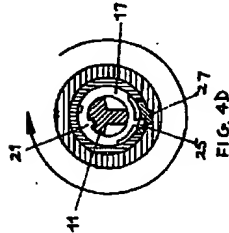


FIG. 4D

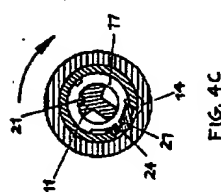


FIG. 4C

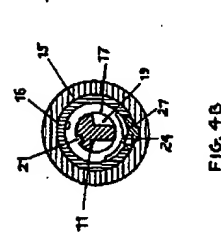


FIG. 4B

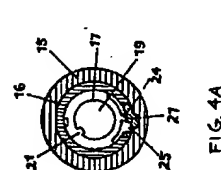
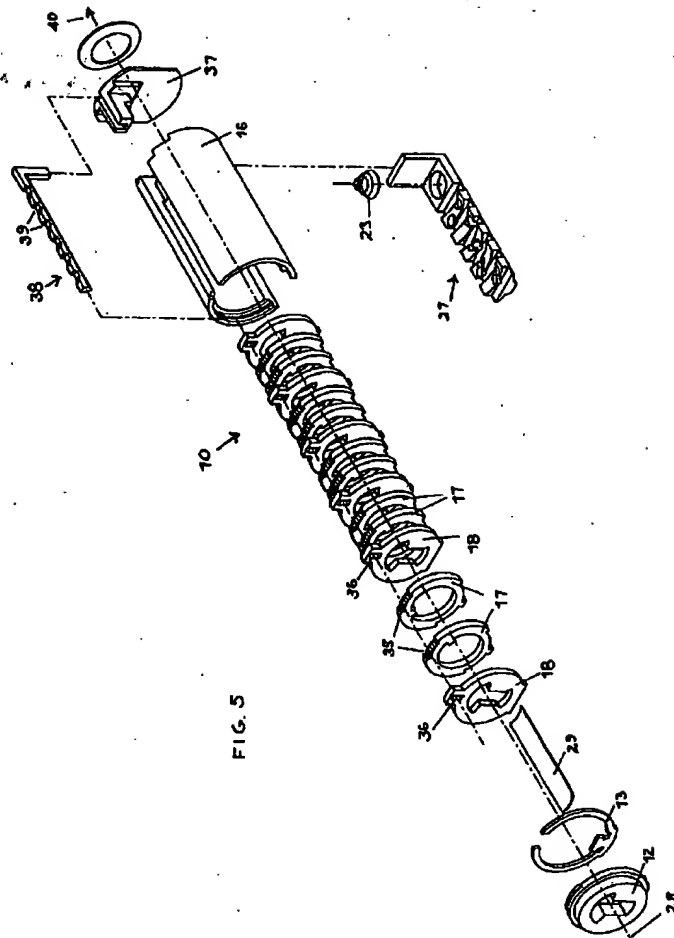


FIG. 4A

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4/4



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